

# **Detecting levee failures with electromagnetic surveys**

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## **Public Comments**

No public comments were received for this proposal.

# Technical Synthesis Panel Review

## Proposal Title

#0274: Detecting levee failures with electromagnetic surveys

Final Panel Rating
adequate

## Technical Synthesis Panel (Primary) Review

### TSP Primary Reviewer's Evaluation Summary And Rating:

All of three of the technical reviewers rated most aspects of this proposal as good to excellent. The hypothesis that EM technology can be used effectively to identify soil moisture content and textural characteristics within the levees is well posed, the workplan is well organized, and there is high likelihood of success in testing the above hypothesis. The authors appear to be well qualified and the budget appears to be reasonable. The primary criticism expressed by the reviewers is that factors other than soil moisture and textural characteristics can affect levee stability; thus, the primary hypothesis that EM technology can be used to assess levee stability may not be adequately tested with the proposed work. In spite of this criticism, the reviewers feel that this study warrants strong consideration for funding.

### Additional Comments:

All of three of the technical reviewers rated most aspects of this proposal as good to excellent. The hypothesis that EM technology can be used effectively to identify soil moisture content and textural characteristics within the levees is well posed, the workplan is well organized, and there is high likelihood of success in testing the above hypothesis. The

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## Technical Synthesis Panel Review

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## Technical Synthesis Panel (Discussion) Review

### TSP Observations, Findings And Recommendations:

The external technical reviewers and the panel agreed that this was a well prepared proposal and that the proposed work was likely to produce useful results. However, the panel had significant concerns regarding the proposed test of the hypothesis that EM technology can be used to assess levee stability. The measurement of soil moisture does not indicate whether a levee is likely to fail because a number of other factors affect the integrity of levees. A more complete model of levee failure is needed for a levee reconnaissance method. Therefore, the panel rated this proposal as Adequate.

# Technical Review #1

proposal title: Detecting levee failures with electromagnetic surveys

## Review Form

### Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	This proposal address the monitoring of Levee system and it's integrity for the Bay Delta plan in order to reduce sea water intrusion. Principal Investigators (PI's) propose to develop a rapid assessment method based on Electromagnetic (EM) surveys to determine the level of integrity of individual Levees. They further propose to remediate the problem by investigating the soft areas discovered during the survey and will be investigated with the excavator and filled with bentonite if required. In this reviewer's opinion, this is a timely problem that California is facing and if done correctly and consistently it will help preventing salt intrusion which can be costly to the local government.
Rating	excellent

### Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

Comments	The hypothesis of the research is that the EM technology can be used to assess failure along miles of delta levees based on soil moisture content and texture characterizations. The specific objective is to test the use of the EM technique to detect
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## Technical Review #1

	locations of potential failure in a short time. During the study authors are planning to calibrate the usage of the EM method. In my opinion although the post measurement calibration using collected soil samples is necessary as proposed by the authors, the main question is if the EM method is a proven technique for that reveals the relationship between the EM measurements and the soil moisture content. This point needs to be clarified in the proposal. The selection of the pilot study is justified if this part is already done.
Rating	very good

## Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	The PI's propose to generate survey maps of soil water content distribution along an irrigation canal. The results are likely to provide some contour maps of the water content distribution to a certain level of variability. Two points are very important to consider here, 1) the science question of the relationship between proposed EM method and the water content has to exist. 2) Post measurement calibration and documentation of soil measurement will be critical to establish accurate maps. If these maps are obtained accurately, they can be helpful to the managers and decision makers and could potentially help major cost incurred as a result of potential levee failure.
Rating	very good

## Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success?

## Technical Review #1

Is the scale of the project consistent with the objectives and within the grasp of authors?

<b>Comments</b>	The proposed approach is simple in application hence it is likely that the PI's will produce the proposed results. Interpretation of the measured results and proof of the soft spots shown in the EM images will be the critical point of the study. The maps will show some level of variability that will need to be normalized with the calibrations obtained from the direct soil measurements.
<b>Rating</b>	very good

## Monitoring

If applicable, is monitoring appropriately designed (pre-post comparisons; treatment-control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

<b>Comments</b>	N/A
<b>Rating</b>	not applicable

## Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

<b>Comments</b>	Maps generated using the EM method will be useful along with the calibration of the measurements using the spoil samples obtained during the test.
<b>Rating</b>	very good

## Additional Comments

<b>Comments</b>	Although the soil Electromagnetic properties is a function of the electrical conductivity and moisture content, limited data has established a quantifiable comparison. This study is proposing to conduct a test
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## Technical Review #1

	to establish such a relationship. Authors may look into the technology of ground penetrating radar to see if in that field the research community has established empirical relationship between the soil properties and the EM waves. The EM frequencies of these methods are different and the relationship will undoubtedly be nonlinear function of the frequency.
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### Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	Authors' track record matches the proposed work. The project team is qualified to implement the proposed project.
Rating	excellent

### Budget

Is the budget reasonable and adequate for the work proposed?

Comments	The budget seems adequate to conduct the study.
Rating	very good

### Overall

Provide a brief explanation of your summary rating.

Comments	In summary I believe this proposal is providing a first order study to establish a relationship between the EM technique and the soil properties. In addition the study has a direct application in monitoring the status of the Levees in Bay Delta project. The weak point of the proposal is that the relationship between the soil properties and the EM method of choice for this proposal is not yet studied in a scientific manner and although this study is proposing a
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Technical Review #1

	measurement in that direction, more work has to be done to justify using this method as routine way of the survey.
Rating	very good

# Technical Review #2

proposal title: Detecting levee failures with electromagnetic surveys

## Review Form

### Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

<b>Comments</b>	<p>Are the goals, objectives ...? Answer: The goals and objectives are clearly stated and internally consistent (3.0/3.0).</p> <p>Is the idea timely and important? Answer: The idea of detecting levee failure by using EM technology is timely, but may not be very important for two reasons: 1) the reliability of EM technology detecting levee failure has not been well documented. How accurate the results could be? What conclusions can we derive from soil moisture content and soil texture? 2) Levee failure can be triggered by many reasons such as seepage and piping, local scour, bank erosion, etc. Soil water content or texture is only one indicator of soil mechanical strength, and it doesn't indicate where the levee failure will occur. However, the reviewer believes that soil moisture content is one of the important factors that may cause levee failure. (1.5/2.0)</p> <p>Rate: 4.5 (Very Good)</p>
<b>Rating</b>	very good

### Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

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## Technical Review #2

<b>Comments</b>	<p>Is the study justified relative to existing ...?  <b>Answer:</b> Intensive literature on EM technology is summarized. The tasks are very well organized, and will likely to achieve the desired results of soil moisture survey in the levee. The application of Mobile Assessment System with EM technology is innovative, and its full implement seems being planned with the irrigation district. However, the linkage between levee failure and soil properties was not addressed. The reviewer believes that other factors (e.g. hydraulics, vegetation, bank slope) should be considered in order to provide an accurate assessment of levee failure potentials. (1.5/2.0)</p> <p>Is a conceptual model ...? <b>Answer:</b> The conceptual model is very clearly stated. (2.0/2.0)</p> <p>Is the selection of research, pilot, or ... <b>Answer:</b> This project is a research demonstration project with potential implementations (1.0/1.0).</p> <p><b>Rate: 4.7 (Very Good)</b></p>
<b>Rating</b>	very good

## Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

<b>Comments</b>	<p>Is the approach well designed and appropriate for meeting ...? Is the approach feasible? <b>Answer:</b> The approaches are very well described. However, soil moisture and texture are important parameters of soil mechanical properties, but is not the only indicator for levee failure. The mechanical properties of levee material should be considered to accurately determine the failure potential (1.0/2.0).</p>
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## Technical Review #2

	<p>Are results likely to add to the base of knowledge ...? Is the project likely to ...? Answer: The results will add our knowledge with regard to using EM technology to detect soil moisture and texture. The project will generate novel methodology and novel information on applying EM to detect soil moisture. (1.5/2.0)</p> <p>Will the information ultimately be ...? Answer: The information will be very useful to decision makers for levee repair. (1.0/1.0)</p> <p>Rate: 3.5 (Good)</p>
Rating	good

## Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success?  
Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	<p>Is the approach fully documented and technically ...? Answer: The approach is fully documented and technically feasible. (2.0/2.0).</p> <p>What's the likelihood of success? Answer: The results of soil moisture and texture related to levee failure, but other factors need to be considered to determine the failure locations (1.0/2.0).</p> <p>Is the scale of the project ...? Answer: The scale of the project is consistent with the general goal. (1.0/1.0) Rate: 4.0 (Very Good)</p>
Rating	very good

## Monitoring

If applicable, is monitoring appropriately designed (pre–post comparisons; treatment–control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

## Technical Review #2

<b>Comments</b>	Not applicable.
<b>Rating</b>	not applicable

## Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

<b>Comments</b>	<p>Are products of value likely from the project? Answer: Yes. Products of value are likely from the project if successful. The product will be very valuable for levee failure detection. However, we don't know whether or not the detected results are accurate, or it's a true indication of levee failure location (1.0/2.0).</p> <p>Are contributions to larger data management systems relevant ...? Answer: Soil information will likely to add extra field data to larger data management system. It will contribute to the larger data management system (1.5/2.0).</p> <p>Are interpretive ... Answer: The results will directly benefit the decision makers (1.0/1.0). Rate: 3.5 (Good)</p>
<b>Rating</b>	good

## Additional Comments

<b>Comments</b>	<p>The proposal goal is very well stated and fit into the mission of CALFED program. The shortcoming is the proposal pointed levee failure only to soil moisture, which is not sufficient. Other related researches in detecting levee failure, or past experience in levee failure study were not reviewed.</p>
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## Technical Review #2

### Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	What is the track record ...? Answer: The past performance of research leaders are good. (2.0/2.0).  Is the project team ...? Answer: The research team will need a geotechnical or civil engineer. (0.5/2.0)  Do they have ...? Answer: The infrastructure and equipment are ready for the research.(1.0/1.0) Rate: 3.5/5.0. (Good)
Rating	good

### Budget

Is the budget reasonable and adequate for the work proposed?

Comments	The budget is reasonable. Rate: 4.0
Rating	very good

### Overall

Provide a brief explanation of your summary rating.

Comments	The proposal addresses a timely topic that fits very well with CALFED program mission. However, soil moisture and texture indicate soil mechanical strength, while the failure of levee is caused by many factors including weaken soil, hydraulic erosion, vegetation rooting, etc. Literature relating to the levee stability research needs to be included.
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## Technical Review #2

	<p>The reviewer gave each question under each category fixed points, for example, there are two questions under Goals, the first one worth 3.0 points, and the second one worth 2.0 points. If two questions are similar, the reviewer will group these two questions. The reviewer gave points to the proposal depending on how well the questions were answered in the proposal. If the questions were addressed perfectly for one category, the proposal will get 5.0 (excellent). Otherwise, fewer points will be assigned.</p> <p>Overall rating is depending on the summation of all points divided by seven, and the points were obtained from seven categories excluding the "not applicable" ones.</p> <p>The overall rating  <math display="block">=(4.5+4.7+3.5+4.0+3.5+3.5+4.0)/7.0= 3.96</math>         (about 4.0)</p> <p>5.0=Excellent; 4.0-5.0=Very Good;          3.0-4.0=Good; 2.0-3.0=Fair; 1.0-2.0=Poor.</p>
Rating	very good

# Technical Review #3

proposal title: Detecting levee failures with electromagnetic surveys

## Review Form

### Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	The objective of testing the feasibility of using electromagnetic (EM) techniques to detect locations of potential failures along levees is clearly stated. However, there are sentences in the proposal that state that EM will be used to assess failure rather than the potential for failure of levees. This leads to confusion for the reader. The idea is timely and important, because developing an efficient technique for determining sites of potential failures in levees would enable maintenance to prevent costly consequences of levee failure.
Rating	very good

### Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

Comments	The importance of maintaining the integrity of the levee system justifies efforts to develop a method capable of accurately identifying potential failures. The EM technology has the potential to measure soil moisture content and texture, which may be related to levee integrity. Implementation of a research scale project is justified.
Rating	

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## Technical Review #3

	<b>very good</b>
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### Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

<b>Comments</b>	The design and approach of the proposed study are appropriate to meet the objective of developing a method to detect potential levee failures. One deficiency in the proposal is that the investigators do not clearly state the expected relationship between soil moisture and texture measured by EM and potential failures. Does coarse texture and high moisture content indicate potential for failure?
<b>Rating</b>	<b>very good</b>

### Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

<b>Comments</b>	The approach is technically feasible, and is documented with literature references. The scale and scope of the project is within the ability of the authors to complete. Information generated by the proposed research is likely to produce, or, at least make progress toward, developing a useful, practical method for detecting potential levee failure.
<b>Rating</b>	<b>very good</b>

### Monitoring

If applicable, is monitoring appropriately designed (pre–post comparisons; treatment–control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

### Technical Review #3

<b>Comments</b>	If a successful method for detecting potential levee failure with EM is developed, it could then be used for monitoring existing levees on a regular basis.
<b>Rating</b>	excellent

## Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

<b>Comments</b>	A successful outcome of the project would produce a practical tool for identifying potential levee failures throughout the Delta and probably in other locations.
<b>Rating</b>	excellent

## Additional Comments

<b>Comments</b>
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## Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

<b>Comments</b>	The investigators are experienced and have the ability and expertise to complete the proposed research. Excellent infrastructure and support are available to accomplish the research.
<b>Rating</b>	excellent

## Budget

Is the budget reasonable and adequate for the work proposed?

### Technical Review #3

<b>Comments</b>	The budget seems appropriate for the two-year research project.
<b>Rating</b>	excellent

## Overall

Provide a brief explanation of your summary rating.

<b>Comments</b>	The proposed research has the potential to produce a practical method for detecting sites of potential levee failures that could be prevented. This could result in a big payoff in terms of effective protection of fresh water supplies, diked waterfowl habitat and manmade structures. My criticism of the proposal is the failure of the authors to clearly state the expected relationship between soil and water characteristics measured by EM and the potential for levee failure. In my opinion this technique is worth testing at some level of funding and effort
<b>Rating</b>	very good

